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U.S.-JAPANESE COOPERATION IN HUMAN SPACEFLIGHT

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.S.-Japanese Cooperation in Human...

HEARING

BEFORE THE

COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED FOURTH CONGRESS

FIRST SESSION

OCTOBER 19, 1995

[No. 22]

Printed for the use of the Committee on Science

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U.S.-JAPANESE COOPERATION IN HUMAN SPACEFLIGHT

THURSDAY, OCTOBER 19, 1995

U.S. HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE
Washington, D.C.

The committee met, pursuant to notice, at 10:05 a.m. in room 2318, Rayburn House Office Building, Hon. Robert S. Walker [chairman of the committee] presiding.

The CHAIRMAN. The hearing will come to order.

During the year in which we commemorate the 50th anniversary of the end of World War II, I am pleased that we have the opportunity to hold this hearing to highlight the successes of the United States and Japan in the area of space cooperation. Our two nations' extensive collaboration in this area began in 1969 with the U.S.-Japanese agreement that gave Japan access to American technology leading to the development of its first N-I and N-II rockets and more recently the H-I.

Since that time, we have formed partnerships in space science, space applications, human space flight, and most notably the international Space Station Alpha to which Japan has pledged over $2 billion for its contribution, the Japanese experimental module. Indeed, Administrator Goldin's presence here demonstrates the importance that NASA places on its partnership with Japan.

Because of Japan's interest in a broad range of space activity, it routinely issues long-term plans and government policies asserting its intent in these areas. The Japanese space budget has been increasing at a rate of 7 to 9 percent per year for the past several years, while space budgets of other nations have been declining.

While our budget for space activities has not enjoyed the same rate of growth of our Japanese allies, the House of Representatives has shown its long-term commitment to the international space station by passing H.R. 1601, the International Space Station Authorization Act of 1995, which will help guarantee stable funding for our contribution to this important scientific endeavor.

On a more personal note, I am pleased to be able to renew the acquaintanceships during this committee's trip to Japan nearly 4 years ago under the leadership of the former chairman, Mr. Brown. During our brief visit to Tsukuba Space Center, we met with Mr. Matsui, who was then the Executive Vice President of NASDA, and his colleagues. We were greeted very warmly. I am happy to be able to return the invitation and wish you a warm visit to this committee today.

We also have today some other distinguished guests from Japan, including the Ambassador, Mr. Kuriyama, and Dr. Mukai, the first Japanese woman to fly in space and the second Japanese astronaut to fly aboard the shuttle. Your presentation on the cooperative space activities between our two nations is eagerly awaited by this committee.

Now I would like to recognize the gentleman from California, Mr. Brown, for an opening statement.

Mr. BROWN. May I express to you, Mr. Chairman, my personal appreciation for your great willingness to convene this meeting and to have this event here in our committee room. I think again it indicates, as I said in a meeting yesterday, that despite changes in the political administration of both of our countries that we are firmly committed to cooperation in space.

I also want to extend our heartfelt welcome to our guests today as we meet to commemorate the great accomplishments that the U.S. and Japan have accomplished in space. Today we are here to look forward rather than back. We are here to commemorate that cooperation in an uplifting and positive way, and we have much to celebrate.

Over the past 50 years, U.S.-Japanese relations have matured and changed in many ways. The great commonality between our two systems has been the role of science and technology and the way we have harnessed it for economic growth and cultural development. Nowhere has this become more evident and symbolic than in the development of our respective space programs.

At the outset, of course, our space programs met very different national needs. The U.S. program was rooted in the Cold War conflict of 30 years ago when we began our program, while the Japanese space program was a critical element in the overall high-tech industrialization that Japan has undertaken. Yet today we see a mirror image in our respective space programs as we share our ambitions for expanding human presence in space and meeting common goals in science.

I might note that this morning's newspaper reports the discovery of a new planetary system, which I am sure that you have all noted, and in a relatively near galaxy. There are other galaxies even closer than this of course, and they probably also have systems which one day we may be exploring with our own astronauts, probably not while I am still alive, but we hope while Dr. Mukai is still alive.

The CHAIRMAN. You have not seen next year's plan yet.

[Laughter.]

Mr. BROWN. No, I have not seen next year's.

The only thing that is certain today is that there will be even greater change in the future. The space program, particularly the human space flight program, will be the stage where we act out and develop further our relationships and roles in the international arena.

Mr. Chairman, I would like to put the remainder of my statement in the record so that we may proceed.

The CHAIRMAN. Thank you, Mr. Brown.

[The statement of Mr. Brown follows:]

PREPARED STATEMENT OF HON. GEORGE E. BROWN, JR.

I want to extend a heartfelt welcome to our guests today as we meet to commemorate the great accomplishments that the U.S. and Japan have accomplished in space.

This year marks the 50th anniversary of the end of World War II. Today, we are here to look forward rather than back. We are here to commemorate this event in an uplifting and positive way. Indeed, we have much to celebrate.

Over the past fifty years, U.S. Japanese relations have matured and changed in many ways. The great commonality between our two systems has been the role of science and technology and the ways we harnessed it for economic growth and cultural development. Nowhere has this become more evident and symbolic than in the development of our respective space programs.

At the outset, of course, our space programs met very different national needs. The U.S. space program was rooted in the cold-war conflict of three decades ago while the Japanese space program was a critical element in the overall high-tech industrialization that Japan undertook. Yet today we see a mirror image in our respective space programs as we share our ambitions for expanding human presence in space and meeting common goals in science. The cold war is over, and the very definitions of cooperation and competition have changed dramatically.

The only thing that is certain today is that there will be even greater change in the future. The space program, particularly the human spaceflight program, will be the stage where we act out and develop further our relationships and roles in the international arena.

Missions such as STS-65 are particularly challenging in melding different cultures, different technologies, and different political systems. It is a privilege today that we have with us two crew members from that mission, one American, Bob Cabana, and one Japanese, Chaiki Mukai. Astronauts the world over have been seen as Ambassadors of good will and symbols of the vision of our future.

I am particularly pleased to welcome all of our guests today, especially Dr. Chiaki Mukai who is a pioneer in many ways. She is not only the second Japanese participant in the Shuttle program, she is also the first Japanese woman to fly in space.

I hope that this, the 50th anniversary of the end of World War II, also marks the beginning of the future of humankind in space. I look forward to the U.S. and Japan leading in that endeavor.

Today, we will review the origins of U.S. Japanese cooperation in space, the successes that have been achieved, and we will begin to think about the nature of future cooperation in space between our two countries.

I am extremely pleased that this event is taking place today and I want to thank our guests who have travelled so far to make this a success, especially the President of NASDA, Mr. Matsui. I also want to welcome the distinguished Ambassador, Mr. Kuriyama, Dan Goldin, a frequent guest of the Committee, and Bob Cabana who not only heads the astronaut office in Houston, he was also the commander of STS-65. I look forward to the discussion.

The CHAIRMAN. Ms. Morella would like to——

Ms. MORELLA. Thank you. I just want to thank you, Mr. Chairman, for assembling such a very distinguished group of panelists. I look forward to hearing from them, recognizing that Japan has increased its commitment, has increased its budget, has increased its desire for cooperative ventures in space. I think we can learn from our colleagues and our friends in Japan about what is happening.

It is a pleasure to see our Ambassador, His Excellency Kuriyama. Mr. Matsui. I am particularly pleased to have Dr. Mukai, who is the woman astronaut who has done such spectacular things and is a role model throughout the world. Of course, Administrator Goldin, it is always a pleasure to have you here. And, Mr. Cabana, you do a wonderful job with assembling all of the astronauts.

So, thank you, Mr. Chairman. I look forward to hearing from the panel.

The CHAIRMAN. Thank you, Ms. Morella.

Are there any other members that wish to make a brief opening statement? Mr. Hall?

Mr. HALL. Yes, Mr. Chairman. I would like to revise and extend, but I would like to join the other members in extending a welcome to Mr. Matsui, President of the National Space Development Agency, and of course to Dr. Mukai and to the others and always to Administrator Goldin, who has done an excellent job in giving us the leadership that was needed so desperately at the time he came on the scene.

I think the hearing is a very important symbol of the close and deep relationship that our countries have. I had the pleasure of doing technical assistance agreements with many Japanese companies for about 15 years, and I always found them reliable, honest, ran good operations, kept their word, a good ally, and we are honored to be a part of this with you.

[The prepared statement of Mr. Hall follows:]

PREPARED STATEMENT OF HON. RALPH M. HALL

Mr. Chairman, I would just like to join the other Members in extending a welcome to Mr. Takashi Matsui, the President of the National Space Development Agency (NASDA) of Japan, Dr. Mukai, and the other members of the Japanese delegation, as well as to Administrator Goldin. I believe that this hearing is an important symbol of the deep and close relationship that has developed between the United States and Japan over the last 50 years.

While the focus of this hearing is our cooperative activities in human space flight, it should be noted that the United States and Japan cooperate across a wide range of space initiatives, including space science missions and environmental research. It is an outstanding record of accomplishment, and one that I am confident will continue in the future.

Mr. Chairman, as you know, I have long been a strong supporter of the International Space Station. I believe it is critically important to the future of the United States space program. However, it also is an impressive example of the benefits of international cooperation and cost-sharing on major R&D projects. I am pleased that Japan has been a strong partner in the Space Station program since its inception. By all accounts, Japan's contribution to the Station is being developed on time and on budget. The Japanese engineers and scientists involved with the Station program are to be congratulated on this accomplishment, and I look forward to the day when the Space Station is operational, with scientists from both our nations conducting world-class research on orbit.

Again, I would like to express my good wishes to our visitors from Japan.

The CHAIRMAN. Thank you, Mr. Hall.

Mr. Sensenbrenner?

Mr. SENSENBRENNER. Thank you very much, Mr. Chairman.

First of all, let me welcome our group of distinguished visitors today and thank you for recognizing me.

As most people know, one of the pages in my portfolio has been to oversee international space cooperation, particularly with respect to the international participation in the space station. One of the reasons why my opening statement will be so short is that we have never had any difficulties with the Japanese developing the space station, unlike some of the other international partners that we have been dealing with. For that, I would like to express my appreciation and commendation.

Perhaps both NASA and other parts of our Government can learn from this cooperation. You in Japan have not redesigned your part of the space station continuously as we have done, and consequently I think it will be more on budget than the initial proposals of the space station that we had once upon a time a long time ago.

Secondly, the fact that our cooperation has gone so smoothly is something that I believe we ought to have our U.S. Trade Representative's office look at and you have your Ministry of International Trade and Industry look at because if the rest of the U.S.-Japan relationship ran as smoothly as the space cooperation did, we would not have any problems at all to discuss with the Japanese, and I think that would be great.

Thank you.

[Laughter.]

The CHAIRMAN. Thank you, Mr. Sensenbrenner.

Any other members?

[No response.]

The CHAIRMAN. Then at this point we would be very happy to hear from His Excellency, Ambassador Kuriyama. We would appreciate your presentation. Thank you for being with us today.

STATEMENT OF HIS EXCELLENCY TAKAKAZU KURIYAMA, AMBASSADOR EXTRAORDINARY AND PLENIPOTENTIARY, THE EMBASSY OF JAPAN, WASHINGTON, D.C.

Ambassador KURIYAMA. Well, thank you, Mr. Chairman.

Mr. Chairman, the honorable members of the House Committee on Science, distinguished guests, ladies and gentlemen, let me at the outset express my most sincere appreciation of the initiative taken by you, Mr. Chairman, and the ranking member of the committee, the Honorable Representative Brown, for bringing about today's memorable event symbolizing how far the United States and Japan have come together over the past half a century since the end of World War II.

Today, 50 years after the war, the United States and Japan are the two largest industrial democracies in the world. Not only are we close friends and allies, but we are partners in many areas in building a more peaceful and prosperous world with greater freedom. As a Japanese who grew up during the time of that dark chapter of rupture in the history of Japan-U.S. relations and as one who has subsequently devoted almost three-fourths of his diplomatic career to the post-war renewal of our bilateral relationship, I cannot but marvel at this remarkable achievement which I believe is a great success story in the history of international relations.

As both of us look back and reflect on the path the two nations have tread over the past half a century, we should not only take pride in what we have accomplished together, but we should also resolve anew to work together in partnership for the next 50 years.

Cooperation in science and technology is now a major pillar of the Japan-U.S. partnership. Japan has benefited greatly from post-war U.S. cooperation in this field. In recent years, however, I am encouraged to note that such cooperation has increasingly matured into a more mutually beneficial, two-way relationship. And space is in an area that convincingly demonstrates this highly positive development of our cooperative ties, as can be witnessed from the space shuttle program and, most typically, from the space station project in which Japan participates as a major partner.

Before concluding, I would like to say just a few words about Dr. Mukai from whom you are about to hear. As the second Japanese

astronaut and the first Japanese woman to take part in the space shuttle program, she needs no introduction, but from today's meeting with her, I am sure that you will find, as I have, a very impressive individual, a woman who is a fine representative of the postwar generation of Japan. In my view she represents on the Japanese side the bright future of the Japan-U.S. partnership, and for this reason I would like to applaud your decision to invite her to this commemorative occasion.

And let me thank you once again, Mr. Chairman, and the committee for giving me this privilege to participate in this morning's meeting. Thank you, Mr. Chairman.

[The prepared statement of Ambassador Kuriyama follows:]

PREPARED STATEMENT OF AMBASSADOR KURIYAMA

Mr. Chairman, the Honorable Members of the House Committee on Science, distinguished guests, ladies and gentlemen.

Let me at the outset express my most sincere appreciation of the initiative taken by you, Mr. Chairman, and the ranking member of the Committee, the Honorable Representative Brown, for bringing about today's memorable event symbolizing how far the United States and Japan have come together over the past half a century since the end of World War II.

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Cooperation in science and technology is now a major pillar of the Japan-U.S. partnership. Japan has benefited greatly from postwar U.S. cooperation in this field. In recent years, however, I am encouraged to note that such cooperation has increasingly matured into a more mutually beneficial, two-way relationship. And space is an area that convincingly demonstrates the highly positive development of our cooperative ties, as can be witnessed from the space shuttle program and, most typically, from the space station project in which Japan participates as a major partner.

Before concluding, I would like to say just a few words about Dr. Muaki, from whom you are about to hear. As the second Japanese astronaut and the first Japanese woman to take part in the space shuttle program, she needs no introduction. But, from today's meeting with her, I am sure that you will find, as I have, a very impressive individual—a woman who is a fine representative of the postwar generation of Japan. In my view, she represents on the Japanese side the bright future of the Japan-U.S. partnership. And for this reason, I would like to applaud your decision to invite her to this commemorative occasion.

And let me thank you, Mr. Chairman, and the Committee for giving me the opportunity to participate in the meeting this morning.

The CHAIRMAN. Thank you, Mr. Ambassador.

Mr. Goldin, we would hear from you next.

STATEMENT OF THE HON. DANIEL S. GOLDIN, ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, WASHINGTON, D.C.

Mr. GOLDIN. Thank you, Mr. Chairman, and I would like to thank you for your vision and leadership and Mr. Brown for holding this historic hearing from our vantage point at NASA.

I have been working with the Japanese in space since the 1960s. One of the things we did right away was exchange teams of people. Americans went to Japan and the Japanese came here. We got a sense of each other's culture and we got to know each other. We gained respect for each other. The first thing I did when I went to Japan was I went to Kyoto, a city of temples and shrines rich in the tradition and culture of Japan, and just walking in the City of Kyoto, you could understand why the Japanese perform the way they do.

Since then I have been to Japan many times and I have worked with the Japanese on many projects. The Japanese consistently deliver a very high quality product. They are committed and trusted partners. You never have to second guess when the Japanese are involved. They do what they say they will do. We see that again and again in our partnership with the Japanese in space.

The U.S.-Japanese partnership is tremendously beneficial to the United States. It is in the best interest of both the United States and Japan.

At the beginning of our work together in space, the U.S. had an advantage technologically. The basic research we have done for decades in this country gave us an edge, but from the very beginning we have learned invaluable lessons from Japan's expertise in management and quality. Both nations have something to give in this partnership. Both are the stronger because of it.

Our relationship with Japan in space has grown significantly over the years. Today NASA works closely with the National Space Development Agency of Japan, NASDA, Japan's Institute of Space and Astronautical Science, ISAS, and Japan's Science and Technology Agency. Thousands of U.S. and Japanese engineers and scientists are working together in ways that benefit both nations. I will not give you a laundry list of all our joint projects with Japan, but let me mention a few.

Clearly the most important one is space station, as Mr. Sensenbrenner has indicated. The space station is an excellent example of how the U.S. and Japan space relationship has strengthened over the years. Japan is one of the original partners. Its commitment has never wavered. Not once have they changed the original agreement on Japan's contribution or schedule. Japan is one of our most steadfast partners in the international space station.

Japan's contribution to the station is the Japanese Experiment Module. This will be used for materials and life sciences experiments. NASA is entitled to 46 percent of the JEM. That is equal to roughly five payload racks inside the pressurized volume and five external payload sites on JEM's exposed facility. Access to the module saves the U.S. money because we do not have to build an exposed facility. It enriches our science.

We are working with Japan on a broad range of initiatives in earth science, space science, microgravity science, astrophysics, and other areas. NASA is participating in the earth science effort that involves Japan, Russia, Europe, and others. Japan is our most significant partner. The Japanese represent over half of the investment being made by all of our international partners in cooperative missions to comprehensively study the Earth system and build predictive climatic models. The Japanese Government has laid out its

long-term science vision and it includes working toward a Global Earth Observation System. Japan has offered to provide up to 25 percent of the required satellites in the next century. Future missions such as the Advanced Earth Observation Satellite, ADEOS, and the tropical rainfall measuring mission, TRMM, will be significant elements of this global effort. Possible follow-on missions are already under discussion.

The flight module of NASDA's ADEOS includes two major U.S. instruments: the NASA scatterometer and the Total Ozone Mapping Spectrometer. The module is currently being integrated for launch in 1996 at Tsukuba Space Center.

In the area of space physics, the Geotail mission launched in July 1992 is another major success. The results are being reported in scientific papers and symposia around the world. The Geotail mission studies the geomagnetic tail regions in the Earth's magnetosphere. This enhances our understanding of the fundamental magnetospheric processes.

The planned Astro-E mission for the flight of the U.S. X-ray Spectrometer aboard the Japanese satellite is another example of our close collaboration and I might say saved us $200 million. This is an astrophysics mission for high resolution x-ray sources such as hot stars, clusters of galaxies, and quasars.

We at NASA have also deepened the human space flight relationship between our two countries. When I came to NASA, Mr. Yamano, then President of NASDA, told me we were not flying enough Japanese astronauts. He was right. Both of us realized how important it would be to our cooperation in space to fly together. Since then Japanese astronauts have flown on the shuttle a number of times. Two payload specialists from Japan have already flown with us, Dr. Chiaki Mukai, who is here with us today, and Dr. Mamoru Mori. Dr. Mukai flew on the successful second international microgravity laboratory mission last year.

Dr. Mukai is an extraordinary person. On her mission last year she operated dozens of U.S and Japanese experiments. It was a tremendous experience for NASA and I believe for her.

Mr. Wakata, Japan's first mission specialist, is scheduled to fly on STS-72 in January. Currently at the Johnson Space Center, Dr. Doi is in our astronaut training program. He will be ready for flight assignment in 1997. NASA has also invited Japan to nominate a third mission specialist.

Through all of NASA's joint projects with Japan, the U.S. has learned a tremendous amount. Both countries are benefiting. For one thing, both nations have the opportunity to get to know something about each other's culture and experience. We begin to see through stereotypes because we are dealing with real people. When you are on opposite sides of the ocean, it is easy to stereotype or pigeon-hole people. It is easy for anger or ignorance to take root, and it is a lot harder when you really know each other, when thousands of people from both countries build relationships. Cooperation in space is helping our country to know each other better. To trust each other and to learn how to work together on highly sophisticated technological projects like the space station.

Another important benefit gained by the U.S. is Japan's input on quality and management.

The U.S. and Japan are natural allies in space. Both have tremendous strengths to bring to the partnership. Both seek to advance breakthroughs in science and technology. Both seek to harness space for the good of our people. Both seek to explore and inspire.

I am getting to know the new President of NASDA, Mr. Matsui. He is a man of vision and integrity. I get the sense that he shares the values we have been talking about. He is committed to the incredible things the U.S. and Japan can do together in space.

The people of Japan and the United States have always been intrigued by the mysteries of the universe. Throughout the ages people have looked up to the heavens in wonder. One of Japan's most famous poets wrote about it some 300 years ago. In an elegant Haiku, Basho described a poor boy who, amidst his toil, looks yearningly up at the sky, and he wrote. "Poverty's child. He starts to grind the rice, and he gazes at the moon."

Thank you very much, Mr. Chairman.

[The prepared statement of Mr. Goldin follows:]

Statement of

Daniel S. Goldin
Administrator
National Aeronautics and Space Administration

before the

Committee on Science
House of Representatives

October 19, 1995

Thank you for the opportunity to appear before this distinguished Committee. I am pleased to share with you NASA's perspective on U.S.-Japanese cooperation in space.

I have been working with the Japanese in space since the 1960's. Before I came to NASA, I worked to form an alliance in space between Hitachi and a U.S. firm. One of the things we did right away was exchange teams of people. The Americans went to Japan, and the Japanese came here. We got a sense of each other's culture. We got to know each other. We gained respect for each other. I went to Kyoto, a city of temples and shrines rich in the tradition and culture of Japan. Since then, I have been to Japan many times. And I have worked with the Japanese on many projects. The Japanese consistently deliver a very high-quality product. They are committed, trusted partners. You never have to wonder or second guess. They do what they say they will do. We see that again and again in our partnership with the Japanese in space.

The U.S.-Japanese partnership is tremendously beneficial to America. It is in the best interest of both the United States and Japan.

At the beginning of our work together in space, the United States had the advantage technologically. The basic research we have done for decades in this country gave us the edge. But from the very beginning, we have learned invaluable lessons from Japan's expertise in management and quality. We have learned a great deal from Japan. Both nations have something to give in this partnership. Both are stronger because of it.

Our relationship with Japan in space has grown significantly over the years. Today, NASA works closely with the National Space Development Agency (NASDA) of Japan, Japan's Institute of Space and Astronautical Science, and Japan's Science and Technology Agency. Thousands of U.S. and Japanese engineers and scientists are working together in ways that benefit both nations. I will not give you a laundry list of all our joint projects with Japan, but let me mention a few.

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Japan's contribution to the Station is the Japanese Experiment Module (JEM). The JEM is an orbital laboratory, exposed facility with robotic arm, and a logistics module for carrying supplies. This will be used for materials and life sciences experiments. NASA is entitled to 46 percent of the JEM. That is equal to roughly five payload racks inside the JEM, and five external payload sites on JEM's exposed facility. Access to the module saves the United States money because we do not have to build an exposed facility.

We are working with Japan on a broad range of initiatives in Earth science, space science, microgravity science, astrophysics, and other areas. NASA is participating in an Earth science effort that involves Japan, Russia, Europe and others. Japan is our most significant partner. The Japanese represent over half of the investment being made by all our international partners in cooperative missions to comprehensively study the Earth system. The Japanese government has laid out its long-term space vision, and it includes working toward a Global Earth Observation System. Japan offers to provide up to 25 percent of the required satellites in the next century. Future missions such as the Advanced Earth Observation Satellite (ADEOS) and the Tropical Rainfall Measuring Mission (TRMM) will be significant elements of this global effort. Possible follow-on missions are already under discussion.

The flight module of NASDA's ADEOS includes two major United States instruments -- the NASA Scatterometer and the Total Ozone Mapping Spectrometer (TOMS). The module is currently being integrated for launch in 1996 at Tsukuba Space Center. The Scatterometer will give us information that is critical to studies of ocean circulation and ocean-atmosphere dynamics. TOMS will provide data that enables us to monitor the ozone layer.

In the area of space physics, the Geotail mission, launched in July 1992, is another success. The results are being reported in scientific papers and symposia. The Geotail mission studies the geomagnetic tail regions of the magnetosphere. This enhances our understanding of the fundamental magnetospheric processes.

The planned Astro-E mission for the flight of U.S. X-ray Spectrometer aboard the Japanese satellite is another example of our close collaboration. This is an astrophysics mission for high resolution of x-ray sources such as hot stars, clusters of galaxies and quasars.

We at NASA have also deepened the human space flight relationship between our two countries. When I came to NASA, Mr. Masato Yamano, then-president of NASDA, told me we were not flying enough Japanese astronauts. He was right. Both of us realized how important it would be to our cooperation in space to fly together. Since then, Japanese astronauts have flown on the Shuttle a number of times. Two Payload Specialists from Japan have already flown with us -- Dr. Chiaki Mukai, here with us today, and Dr. Mamoru Mori. Dr. Mukai flew on the successful second international micro-gravity laboratory mission last year.

Dr. Mukai is an extraordinary person. She is the second Japanese astronaut to fly on the Shuttle, and the first Japanese woman in space. On her mission last year, she operated dozens of U.S. and Japanese experiments. It was a tremendous experience for NASA, and I believe, for her.

Mr. Koichi Wakata, Japan's first Mission Specialist, is scheduled to fly on STS-72 in January. Currently at Johnson Space Center, Dr. Takao Doi is in our astronaut training program. He will be ready for flight assignment in 1997. NASA also has invited Japan to nominate a third mission specialist.

One last word about Japanese astronauts. On one of his last visits before he retired, Mr. Yamano told me that he thought more Japanese astronauts should be assigned to Shuttle missions because every time they were, the Shuttle launches on schedule.

We are also pleased that a NASA employee, Ms. Amy Jackson from our Office of External Relations, was chosen as one of seven U.S. Mansfield Fellows. She will spend the next year intensively studying Japanese, and then spend a year in Tokyo working on Japanese-U.S. space cooperation.

Through all of NASA's joint projects with Japan, the United States has learned a tremendous amount. Both countries are benefiting. For one thing, both nations have the opportunity to get to know something about each other's culture and experience. We begin to see through the stereotypes because we are dealing with real people. When you are on opposite sides of an ocean, it is easy to stereotype or pigeon-hole people. It is easy for anger or ignorance to take root. It is a lot harder when you really know each other -- when thousands of people from both countries are building relationships.

Cooperation in space is helping our countries to know each other better. To trust each other and to learn how to work together on highly sophisticated technological projects like the Space Station. Another important benefit gained by the United States is Japan's input on quality and management.

We are confident that our relationship with Japan will continue to grow. We were very pleased that a recent report by the Japanese Space Activities Commission addressed the issue of international partnerships. The report, published in July 1994, placed a new emphasis on expanded international cooperation.

The United States and Japan are natural allies in space. Both have tremendous strengths to bring to this partnership. Both seek to advance breakthroughs in science and technology. Both seek to harness space for the good of our people. Both seek to explore and inspire.

The people of Japan and the United States have always been intrigued by the mysteries of the universe. Throughout the ages, people have looked up to the heavens in wonder. One of Japan's most famous poets wrote about it some 300 years ago. In an elegant Haiku, Basho described a poor boy who, amidst his toil, looks yearningly up to the sky.

He wrote: Poverty's child -
he starts to grind the rice,
and gazes at the moon.

Thank you.

The CHAIRMAN. Mr. Goldin, were you going to present Mr. Cabana?

Mr. GOLDIN. Yes.

The CHAIRMAN. Would you do that? Then we will go on to Mr. Matsui at that point.

Mr. GOLDIN. Mr. Chairman, it gives me tremendous pleasure and honor to introduce one of the great U.S. astronauts, Bob Cabana. He is head of the Astronaut Office. He provides leadership and guidance and support for our human space flight program. He has flown with our Japanese friends, and it gives me great pleasure to introduce Mr. Cabana.

The CHAIRMAN. Mr. Cabana, thank you.

STATEMENT OF COLONEL ROBERT D. CABANA, USMC, CHIEF, ASTRONAUT OFFICE, COMMANDER, STS-65, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Colonel CABANA. Thank you, Mr. Goldin.

Mr. Chairman, it is indeed a pleasure for me to be here with all of you this morning. I have a short statement that I would like to submit for the record, if that is acceptable.

The CHAIRMAN. That will be fine. Without objection.

Colonel CABANA. I would just like to say it was indeed a privilege and a pleasure for me to command STS-65 and fly with Dr. Mukai. The second international microgravity lab mission set the groundwork for space station, and we are going to go on beyond that. Japan was an integral partner on that mission. It was fantastic, the cooperation and the success that we achieved. But it is only the beginning and we are going to go beyond that.

[The prepared statement of Colonel Cabana follows:]

Statement for the Record

of
Colonel Robert D. Cabana, USMC
Chief, Astronaut Office
Commander, STS-65
National Aeronautics and Space Administration

before the
Committee on Science
House of Representatives

October 19, 1995

Distinguished ladies and gentlemen, it is indeed an honor, as the Commander of STS-65, to share with you the success of the Second International Microgravity Lab (IML-2) mission which was conducted on board the Space Shuttle Columbia in July of 1994. I was privileged to have a remarkable crew that was able to accomplish all of the mission objectives on this demanding flight. The pride and joy I felt in my crew after a successful mission following "wheels-stop" at the Kennedy Space Center is something which I will treasure forever.

IML-2 consisted of 82 materials and life science experiments involving more than 200 investigators from 15 countries and six space agencies. A total of 19 experiment facilities were used to conduct the science investigations which included human physiology, fluid physics, electrophoresis, animal behavior and embryo development in microgravity, radiation monitoring, acceleration data measuring, containerless materials processing, crystal growth and medical evaluations of crew health and safety on long duration missions.

Key to the success of this flight was the incorporation of a number of Japanese experiments provided by NASDA, the National Space Development Agency of Japan, including the Large Isothermal Furnace for Materials Science, the Vibration Isolation Box Experiment System, the Free Flow Electrophoresis Unit for Bioprocessing, the Aquatic Animal Experiment Unit for Space Biology and the Real-Time Radiation Monitoring Device for Radiation Biology. Additionally, this mission was fortunate to have a Japanese Payload Specialist, Dr. Chiaki Mukai, the first Japanese woman in space, who was an integral member of the crew and contributed immeasurably to the success of the flight.

Although STS-65 set the record for the longest Space Shuttle mission to that date, as well as a number of other firsts in the field of microgravity research, the real success of the mission was in paving the way for future cooperation aboard the international Space Station. What we accomplished together in two weeks will pale in comparison to what we can accomplish working together aboard a permanent, world class, laboratory in low Earth orbit.

Who is to say what the next 100 years of human space flight will bring? We are only limited by our imagination and our desire and resolve to accomplish the goals we set for ourselves. The space program challenges and motivates us. It binds us together and causes us to reach a little higher. It s human destiny to explore, to learn and to reach beyond our known world. This is what the space program does for us. It expands our horizons, it makes life a little better for everyone on Earth, and it prepares us to cope with the unknowns that the future holds for us. It is essential to the future of our civilization.

Working together we can meet these challenges, and more, as we explore beyond our boundaries. Thank you.

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The CHAIRMAN. Thank you very much.

Mr. Matsui, we would be pleased to have your presentation at this point.

STATEMENT OF MR. TAKASHI MATSUI, PRESIDENT, THE NATIONAL SPACE DEVELOPMENT AGENCY OF JAPAN, TOKYO, JAPAN

Mr. MATSUI. Mr. Chairman, Congressman George Brown, and distinguished members of the Committee on Science, I would like to express my sincere gratitude for inviting Dr. Mukai and myself to your committee on the occasion of the commemorative hearing to mark the 50th anniversary of the end of World War II to speak about some of the remarkable achievements of Japan-U.S. cooperation in space.

40 years ago Japan took a small first step towards the new frontier in space and since then we have steadily continued to pursue our goal and have achieved different results. The progress of space development in Japan throughout these years cannot be described without referring to the cooperation between Japan and the United States. For example, launch vehicles such as the early N-I, N-II, and the H-I rockets and different types of satellites were developed with technological support from the U.S. We were fortunate enough to learn a great deal from these cooperative efforts which now result in the various Japan-U.S. joint missions in a broader range of space development.

I would like to refer to some examples of cooperation between our two countries, starting with the international space station project.

The international space station project has started under the initiative of the U.S. and has been promoted as a truly international venture among the U.S., European countries, Canada, Russia, and Japan. NASDA has been developing the Japanese experiment module, JEM, as the Japanese contribution to this project. Participation in this international project is now the largest investment in the history of Japanese space development.

I am confident that Japan, aiming at the launch of JEM in the year 2000, will continue its best efforts to maintain its position as a reliable partner to the U.S. in the international space station project.

The Japan-U.S. partnership has been prominent in the recent microgravity experiments which we have undertaken with the cooperation of American scientists using the space shuttle. These experiments are an essential step toward the future utilization of the space station. Dr. Mukai, whom I will have the great pleasure to introduce to this committee later, has conducted a mission that is nothing short of an excellent example of a successful Japan-U.S. collaboration.

Earth observation, which is now recognized as an important means to help solve common issues of mankind concerning, among others, the preservation of the Earth's environment, also benefits from the cooperation between our two countries. For the Japanese advanced Earth observing satellite, NASA will provide two sensors designed to monitor maritime and atmospheric conditions. These will be added to the five Japanese sensors and one to be provided by France.

Another joint project is the tropical rainfall measuring mission in which Japan will develop a precipitation radar and launch the satellite by the H-II launch vehicle while NASA will provide other sensors and the satellite bus.

The construction of a global information network for quick and effective access to data from Earth observation satellite is another concept advocated by the U.S. We at NASDA recognize the importance of this network and have begun to make our contributions toward its realization.

International cooperation has become an essential factor for many science and technology projects and future space development activities in particular. Accordingly, it is NASDA's policy to take an active part in the future international cooperation projects.

We recognize that the House Science Committee plays a key role in forming the U.S. space science and technology policy. I am grateful that Japan-U.S. cooperation in the past has benefited from your support and also look forward to your greater understanding and consideration.

I now would like to conclude by introducing Dr. Chiaki Mukai, the first Japanese woman to fly in space as a crew member of STS-65. The mission of this flight, the second international microgravity laboratory, was conducted under the cooperation of the U.S., Europe, Canada, and Japan.

Dr. Mukai acquired a doctorate in medicine at Keio University and has worked in the clinical and research fields of cardiovascular surgery. In 1985 she was selected as one of the payload specialist candidates for the STS-47 mission. From 1987 she studied cardiovascular physiology at the Biomedical Research Institute at Johnson Space Center and also served as a backup PS for STS-47. During the 15-day mission of IML-2, she worked with Dr. Cabana, whom I can see here today, and other U.S. crew members to conduct 82 experiments in life science and material science areas. She is now involved in analyzing experiment results from the IML-2 mission and studies in the space medical field as one of the representative investigators for life science experiments to be conducted in the JEM.

I believe that through this opportunity Dr. Mukai will be able to highlight in addition to her own experience some of the outstanding cooperative activities in which other Japanese astronauts have or will participate in partnership with American counterparts.

Once more may I say how much I appreciate this opportunity that the Committee on Science has provided us today. My best wishes and full support goes to all members of this committee who will establish a future vision in space for the United States.

Thank you.

[The prepared statement of Mr. Takashi Matsui follows:]

STATEMENT OF TAKASHI MATSUI
PRESIDENT OF NATIONAL SPACE DEVELOPMENT AGENCY OF JAPAN
(NASDA)
BEFORE THE
COMMITTEE ON SCIENCE
UNITED STATES HOUSE OF REPRESENTATIVES
OCTOBER 19, 1995

Mr. Chairman, Congressman George Brown and distinguished members of the Committee on Science,

I would like to express my sincere gratitude for inviting Dr. Mukai and myself to your Committee on the occasion of the commemorative hearing to mark the 50th anniversary of the end of World War II, to speak about some of the remarkable achievements of Japan-U.S. cooperation in Space.

Forty years ago, Japan took a small first step towards the new frontier in space, and since then we have steadily continued to pursue our goals and have achieved significant results. The progress of space development in Japan throughout these years, and especially since the National Space Development Agency of Japan (NASDA) was established in 1969, can not be described without referring to the cooperation between Japan and the United States. For example, launch vehicles such as the early N-I, N-II and H-I rockets and different types of satellites were developed with technological support from the U.S. We were fortunate enough to learn a great deal from these cooperative efforts which now result in the various Japan - U.S. joint missions in a broader range of space development.

I would like to refer to some examples of cooperations between our two countries, starting with the International Space Station Project.

The International Space Station Project has started under the

initiative of the U.S. and has been promoted as a truly international venture among the U.S., European countries, Canada, Russia and Japan. NASDA has been developing the Japanese Experiment Module, JEM, as the Japanese contribution to this project. Participation in this international project is now the largest investment in the history of Japanese space development, as one-third of the annual budget of NASDA is now earmarked for the development of JEM, and 72% of its production has already been contracted.

I am confident that Japan, aiming at the launch of JEM in the year 2000, will continue its best effort to maintain its position as a reliable partner to the U.S. in the International Space Station Project.

Japan-U.S. partnership has been prominent in the recent microgravity experiments which we have undertaken with the cooperation of American scientists, using the Space Shuttle. These experiments are an essential step towards the future utilization of the Space Station. Dr. Mukai, whom I will have the great pleasure to introduce to this committee later, has conducted a mission that is nothing short of an excellent example of a successful Japan-U.S. collaboration, and will elaborate on this aspect of our cooperation.

Earth Observation, which is now recognized as an important means to help solve common issues of mankind concerning, among others, the preservation of the Earth's environment, also benefits from the cooperation between our two countries. For the Japanese Advanced Earth Observing Satellite, ADEOS, NASA will provide two sensors designed to monitor maritime and atmospheric conditions. These will be added to the five Japanese sensors and one to be provided by France. Another joint project is the Tropical Rainfall Measuring Mission, TRMM, in which Japan will develop a precipitation radar and launch the satellite by the H-II launch vehicle, while NASA will provide other sensors and the satellite bus.

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We recognize that the House Science Committee plays a key role in forming the U.S. space/science and technology policy. I am grateful that Japan-U.S. cooperation in the past has benefitted from your support, and also look forward to your greater understanding and consideration.

Mr. Chairman, I now would like to conclude by introducing Dr. Chiaki Mukai, the first Japanese woman to fly in space in July last year as a crew member of the Space Shuttle Colombia, STS-65.

Dr. Mukai recieved a doctor of Medicine degree in 1977 and worked in the clinical and research fields of cardiovascular surgery as a general resident in the Keio University School of Medicine and recieved a doctorate in physiology in 1988 from the same university. In 1985, she was selected as one of the Payload Specialist candidates for the STS-47 mission. From 1987 she studied cardiovascular physiology at the Biomedical Research Institute of Johnson Space Center and also served as a backup PS at Marshall Space Flight Center for STS-47. During the 15- day mission of the Second International Microgravity Laboratory aboard STS-65, she worked with Dr.Cabana, whom I can see here today, and other U.S. crew to conduct 82 experiments in life science and material science. She is now involved in analyzing experiment results from the IML-2 mission and is also an

Principal Investigator planning an immunological experiment to be conducted in the JEM.

I believe that through this opportunity, Dr. Mukai will be able to highlight, in addition to her own experience, some of the outstanding cooperative activities in which other Japanese astronauts have or will participate in partnership with their American counterparts.

Once more may I say how much I appreciate this opportunity that the Committee on Science has provided us today. My best wishes and full support goes to all the members of this committee who will establish a future vision in space for the United States.

The CHAIRMAN. Thank you, Mr. Matsui.

Dr. Mukai, we will be very happy to hear from you. One of the great pleasures of this committee is to be able to welcome our astronauts and hear about their experiences and hear about their work. We are especially delighted to have you with us today to hear your report. So, we would be happy to have your presentation.

STATEMENT OF DR. CHIAKI MUKAI, M.D., PH.D., ASTRONAUT, THE NATIONAL SPACE DEVELOPMENT AGENCY OF JAPAN, TOKYO, JAPAN

Dr. MUKAI. Thank you. Chairman Walker, Ranking Democrat Member Mr. Brown, and distinguished members of the Science Committee of the House of Representatives of the United States Congress, it is an honor and a pleasure to have this opportunity to present my thoughts on the U.S.-Japan cooperation in science and technology. You, the United States Congress, are one of the most important venues affecting global science and technological progress.

Given this opportunity, I would like to speak about the U.S.-Japan cooperation in space development, especially in the field of manned space activities. Today Japan's manned space activities, as conducted through cooperation between the United States and Japan, are one of the fruits of post-war cooperation between our countries. I speak today from the viewpoint of a Japanese astronaut who represents one example of the American and Japanese cooperation during the 50 years after World War II. I would like to explain how the manned space program is understood by the Japanese people and how their awareness of it has changed over the past 50 years, although I am a little too young to cover this entire period. I would also like to introduce the history and the current status of the Japanese manned space program, highlighting the cooperative efforts between the United States and Japan.

First let me explain how I became involved in the manned space program. Many people asked me if I had a childhood dream to be an astronaut. The answer is no. I had never dreamt of being an astronaut actually until I was 32 years old. Allow me to explain.

It was in 1957 that the Sputnik circled the Earth. I was only 5 years old then. At that time almost no Japanese person was even aware of the space program, much less the fact that manned efforts to explore the frontier were in preparation. More than that, it was difficult to even imagine that 37 years later a Japanese woman would soar into space for the first time in history.

Throughout my childhood there were many epoch-making events within the manned space program. For example, in 1961 Yuri Gagarin became the first human being to orbit the Earth and reported about our blue planet. Teleshkova became the first woman in space in 1963. On July 20, 1969, Apollo 11 landed on the moon and the American astronaut Neil Armstrong became the first person to walk on the Moon.

We were very excited by those feats that were supported by the development of science and technology and we also were deeply impressed by the power of America's national resources and resolve. Those achievements inspired me to search out and read biographies of these history makers. During those early days, that was the ex-

tent of my interest with regard to any personal aspirations in space exploration. I felt that those marvelous things were beyond any personal reach, occurring in what appeared to be worlds away.

I believe the majority of the Japanese people had the same feelings although the National Space Development Agency of Japan, NASDA, the Japanese space agency, had already been established and started launch vehicle and satellite development in 1969.

My first dream when I was a child was to be a doctor so that I could help people suffering from diseases. Fortunately, I achieved my dream and I chose to specialize in cardiovascular surgery.

In 1983 one article in the newspaper changed my life. It said that NASDA was seeking Japanese candidates, hopefully scientists, for a chance to conduct space experiments aboard the U.S. space shuttle in 1988. I was stunned realizing that the progress of science and technology in the 20th century had indeed developed an advanced space program so progressive that it enabled ordinary people working on Earth to travel beyond this planet and expand their professions and activities into space. Times have really changed, I thought to myself.

The kind invitation from the United States to Japan to use the space shuttle for space experiments opened the door to manned space activities in Japan. We are now living in an era of utilizing the space environment and realizing its value as a precious resource. What a wonderful era in which to be living. As I was being impressed by the progress of the space program, I grew more and more intrigued about personally seeing our blue planet from outer space. I wondered if such a magnificent experience would truly expand my concept of life itself and deepen my way of thinking. At the same time, I was greatly fascinated by the space environment, particularly microgravity, for research purposes. I saw it as an opportunity to contribute my medical expertise to the space program.

In 1985 I was lucky enough to be selected by NASDA as one of three candidates targeted for a 1988 shuttle flight called the Spacelab-J mission, a shared mission effort between the United States and Japan using Spacelab. My second dream, which was to travel into and work in outer space, had begun. This was the beginning of Japan's manned space program.

Turning to Japan's history of the manned space program, two Japanese astronauts have currently flown aboard the space shuttle. Dr. Mamoru Mohri flew aboard the Spacelab-J mission, STS-47, as the first Japanese payload specialist in 1992. Spacelab-J was a bilateral cooperative program between the United States and Japan. I served as one of the two backup payload specialists for Dr. Mohri.

I was very fortunate and happy to be the second Japanese science astronaut for the second international microgravity laboratory, IML-2/STS-65, as a payload specialist in July 1994. IML-2 was a multilateral program conducted by the United States, Japan, European countries, and Canada aboard the shuttle. This mission lasted for 2 weeks.

I would like to briefly introduce you to the international microgravity laboratory, the second mission, emphasizing the scientific and international benefits. The mission consisted of 82 investigations which addressed space life sciences and microgravity research. The space life sciences on which we focused were human

physiology, space biology, radiation biology, and bioprocessing. Investigations regarding microgravity research encompassed material processing, fluid science, and research on microgravity environment and countermeasures. The results of our mission's 82 experiments will be reported by each principal investigator to NASA this November.

I also participated in the program as one of the investigators on calcium metabolism. This is directly related not only to the astronaut's health in space, but also to the people suffering from osteoporosis, or brittle bones, encountered with aging. We cultivated osteoblasts which have an important role in bone mineralization. Our preliminary results suggest that in space production of a special protein essential to bone formation and mineralization was reduced by 90 percent—9, 0 percent—and a substance triggering bone absorption increased by a factor of 10.

Based on these results, we are now designing a next- step experiment to countermeasure this brittle bone phenomenon which occurs in space. If the countermeasure is verified effective in space, it will pave the way to helping people suffering from bone resorption on Earth. To evaluate the efficacies and the potential side effects of these countermeasures, experiments of longer duration in space such as that aboard the space station are required.

Let us take the IML-2 mission as an example of U.S.-Japan cooperation. The United States provided essential elements for the mission such as the space shuttle and its operations including resource and time line management. Japan provided several facilities for experiments such as an aquatic animal experiment unit, and Japan gave 50—5, 0—percent of the time allotted for their facilities to the United States investigators who wanted to use them for their own experiments. This, thereby, greatly reduced the overall expenses for the mission for both space agencies.

Allow me here to mention a personal concern which I had before the mission. When I started to work for this flight, my first thought was how are we going to make a team out of people from 15 different countries, people from six different space agencies, several NASA flight centers, and hundreds of scientists. How are we ever going to be able to function as one team together? I am proud to say that we did just that. As the lead agency, NASA did a wonderful job in distributing the precious resources of crew time, electrical power, and so on to the 82 investigations and integrated a very efficient time line.

The aspects of crew operations were both exciting and rewarding in terms of international benefits of this mission. The crew discovered that we could provide the link between agency and agency, scientist and scientist, and engineers and engineers. This liaison function was shown in terms of language, procedures, and learning and adopting one culture to another. Our networking resulted in resource sharing among the agencies and scientists, thereby maximizing the scientific output to all parties. This multilateral collaboration further resulted in a greater sharing of data and a dramatic reduction in redundancy.

A perfect illustration of this team spirit occurred during our flight. The cooling system of the Japanese electrophoresis unit inside the Spacelab was shut down because of air bubbles and we

could not run any experiments. Based upon standard operational procedures, we continually purged water in the system to no avail. After determined communications between all of the agencies, we were told to take some pieces off the European facility, some pieces off the space shuttle, and some pieces from the Japanese hardware in order to build a special water purging device. In addition, the Canadian team changed their experimental time line, a very generous offer, as time is a precious commodity, to allow for the fixing of the unit. This option was formulated by the people of the Marshall Space Flight Center, the Johnson Space Center, and the Kennedy Space Center. It was only through this extraordinary global effort and the leadership of NASA that such a solution was successfully realized.

Through the IML-2 mission, I felt that the science community was eager to be involved with science in space. We encountered language, cultural, operational, and procedural differences which at times were difficult. Yet, we can say that we were successful in our quest for a productive and beneficial mission. Indeed, the IML-2 was one of the most successful Spacelab missions. It was a great honor for me to have the pleasure of working with such outstanding people as in the IML-2 mission. I hope this wonderful experience and expertise we have gained as a team can contribute to future missions.

Now I would like to move forward to the future of the U.S.-Japan cooperation in manned space programs.

As for the immediate future, Mr. Koichi Wakata, Japan's first mission specialist, will fly on the space shuttle endeavor for STS-72 in January 1996. The space flyer unit, a Japanese satellite launched by a Japanese H-II rocket, will be retrieved by Mr. Wakata using the space shuttle's manipulator arm.

In 1997 the first element for the international space station will be launched. Japan will provide that program with the Japanese Experiment Module. Procurement of parts and components for the JEM, Japanese Experiment Module, flight model has begun in Japan and JEM will be launched in 2000 by the space shuttle. In return for the U.S.-provided resources such as electricity and oxygen, Japan will offer 50 percent—5, 0 percent—of the use of JEM to the U.S. to conduct experiments.

Further supporting this program, this September NASDA began efforts to recruit the fifth Japanese astronaut candidate who will work on the assembly of JEM for the space station.

With this history of U.S.-Japan cooperation in mind, the manned space program is understood in today's Japan basically in terms of four aspects.

First, science and technology are integral driving forces for Japan to realize national development complementing its limited natural resources. And space development, particularly advanced R&D, will be essential for the future of Japan. Ultimately this will contribute to the wellbeing of the people all over the world.

Second, international cooperation is essential for Japan in order to realize a manned space program. Previous examples of successful cooperation with the United States in manned space activities have made the Japanese people feel that international cooperation will result in greater achievements.

Third, manned space program contributes to education. It enhances people's motivations and dreams to seek better ways of life. Many people, both children and adults, with whom I have talked after my flight, expressed greater interest in the future possibility that they themselves will be able to travel, live, and work in space. What is noteworthy here is that Japanese children today believe they can become professional astronauts, whereas when I was a child, to be a Japanese astronaut seemed an unbelievable dream. The manned space program also teaches these potential astronauts the importance of dreams of science and technology, of teamwork, and of being a good member in the international society on our planet.

Fourth, the space program makes us aware that this small planet is the only place for humans to live. We need to cooperate with each other and share as well as protect our precious Earth for ourselves and our children. Although it is not visible, I would like to say that this awareness which I call a spiritual spinoff is one of the most beneficial from the space program. For without awareness, nothing comes into being.

To enjoy those benefits of manned space program now and in the future, Japan is determined to maintain its commitment to the space station program. Thanks to the cooperation of the United States, the Japanese manned space program today is able to contribute to manned space endeavors with the United States and others such as the international space station program.

Japan will continue to support the international space station program as led by the United States by developing space station facilities for space experiments, by sending Japanese astronauts to be trained at NASA, and by exchanging information and ideas in the fields of advanced science and technology. In the future I hope Japan will be able to contribute to transporting materials to and from space using the H-II launch vehicle. These Japanese resources will extensively contribute to the international space community. I hope the U.S. and Japan will continue its cooperation in order to advance global science and technology and for the betterment of human welfare into the 21st century.

With imagination and creativity, we as fellow human beings can devise better ways to cooperate. With courage we can implement those better ways. The IML-2 mission did it and I believe that we as an international team will continue to progress from the space shuttle to the space station and beyond. We have everything to gain.

On a personal note, I am grateful to have had the opportunity to journey into space. As an earthling once again, I feel that my good fortune yet continues. Being invited here today, I welcome the opportunity to personally extend my heartfelt gratitude to all of you in this room. It was the American people who taught me the idea that if you can dream, you can do it. It was your support and encouragement that has shouldered me throughout my quest to seek out new knowledge, and I thank you.

[The prepared statement of Dr. Chiaki Mukai follows:]

Statement of
Chiaki Mukai, M.D., Ph.D.
Payload Specialist
The Second International Microgravity Laboratory

Astronaut
Astronaut Office
National Space Development Agency of Japan
Ibaraki-ken, Japan

before the Committee on Science
United States House of Representative

October 19, 1995

The Chairman Mr. Walker, Ranking Democrat Member Mr. Brown, and distinguished members of the Science Committee of the House of Representatives of the United States Congress:

It is an honor and pleasure to have this opportunity to present my thoughts on the US-Japan cooperation in science and technology. You,the United States Congress, are one of the most important venues effecting global science and technological progress.

Given this opportunity,I would like to speak about the US-Japan cooperation in space development, especially in the field of manned space activities. Today, Japan's manned space activities as conducted through cooperation between the United States and Japan, are one of the fruits of postwar cooperation between our countries. I speak today from the viewpoint of a Japanese astronaut which is one example of the American and Japanese cooperation during the fifty years after World War II. I would like to explain how the manned space program is understood by the Japanese people and how their awareness to it has changed over the past fifty years, although I am a little too young to cover

this entire period. I would also like to introduce the history and current status of the Japanese manned space program, highlighting the cooperative efforts between the United States and Japan.

First, let me explain my involvement in the manned space program. Many people have asked me if I had a childhood dream to be an astronaut. The answer is no. I had never dreamed of being an astronaut -- actually, until I was thirty-two years old. Allow me to explain. It was in 1957 that the Russian Sputnik circled the earth. I was only five years old then. At that time almost no Japanese person was even aware of the space program, much less the fact that manned efforts to explore the frontier were in preparation. More than that, it was incredulous to even imagine that 37 years later, a Japanese "woman" would soar into space for the first time in history. Throughout my childhood, there were many epoch-making events, within the manned space program. For example, In 1961, Yuri Gagarin, became the first human being to orbit the earth, and reported about our "blue planet". Teleshkova became the first woman in space in 1963. On July 20, 1969, Apollo 11 landed on the Moon and the American astronaut, Neil Armstrong, became the first person to ever walk on the Moon. We were very excited by those feats that were supported by the development of science and technology, and we also were deeply impressed by the power of America's national resources and resolve. Those achievements inspired me to search out and read biographies of these history makers. During those early days, that was the extent of my interest with regard to any personal aspirations in space exploration. I felt that those marvelous things were beyond any personal reach -- occurring in what appeared to be worlds away.

I believe the majority of the Japanese people had the same feelings although, the National Space Development Agency of Japan (NASDA), the Japanese space agency, had already been established and started launch vehicle and satellite development in 1969.

My first dream, when I was a child, was to be a doctor so that I could help people suffering from diseases. Fortunately, I achieved my dream and I chose to specialize in cardiovascular surgery.

In 1983, one article changed my life. It said that NASDA was seeking Japanese candidates, hopefully scientists, for a chance to conduct space experiments aboard the US Space Shuttle in 1988. I was stunned, realizing that the progress of science and technology in the twentieth century had indeed developed an advanced space program. So progressive that it enabled ordinary people working on Earth to travel beyond this planet and expand their professions and activities into space. "Times have really changed." I thought to myself.

The kind invitation from the US to Japan to use the Space Shuttle for space experiments opened the door to manned space activities in Japan. We are now living in an era of utilizing the space environment and realizing its value as a precious resource. What a wonderful era in which to be living! As I was being impressed by the progress of the space program, I grew more and more intrigued about personally seeing our blue planet from outer space. I wondered if such a magnificent experience would truly expand my concept of life itself and deepen my way of thinking. At the same time, I was greatly fascinated by the space environment, particularly microgravity, for research purposes. I saw it as an opportunity to contribute my medical expertise to the space program.

In 1985, I was lucky enough to be selected by NASDA as one of three candidates targeted for a 1988 Shuttle flight called the Spacelab-J (SL-J) mission, a shared mission effort between the US and Japan using Spacelab. My second dream, which was to travel into, and work in, outer space had begun. This was also the beginning of Japan's manned space program.

Turning to Japan's history in the manned space program, two

Japanese astronauts have currently flown aboard the Space Shuttle.

Dr. Mamoru Mohri flew aboard the SL-J mission/STS-47 as the first Japanese Payload Specialist in 1992. Spacelab J was a bilateral cooperative program between the US and Japan. I served as one of the two backup Payload Specialists for Dr. Mohri.

I was very fortunate and happy to be the second Japanese science astronaut for the Second International Microgravity Laboratory, IML-2/STS-65, as a Payload Specialist in July 1994. IML-2 was a multilateral program conducted by the US, Japan, European countries, and Canada aboard the Shuttle. This mission lasted two weeks.

I would like to briefly introduce you to the IML-2 Mission emphasizing the scientific and international benefits. The mission consisted of 82 investigations which addressed Space Life Sciences, and Microgravity Research. The Space Life Sciences on which we focused were, Human Physiology, Space Biology, Radiation Biology, and Bioprocessing. Investigations regarding Microgravity Research, encompassed Material Processing, Fluid Science and Research on Microgravity Environment and Countermeasures. The results of our mission's 82 experiments will be reported by each principal investigator to NASA this November.

I also participated in the program as one of the investigators on calcium metabolism. This is directly related not only to the Astronauts' health in space, but also to the people suffering from osteoporosis or brittle bones encountered with aging. We cultivated osteoblasts which have an important role in bone mineralization. Our preliminary results suggest that, in space, production of a special protein essential to bone formation and mineralization was reduced by 90%, and a substance triggering bone absorption increased by a factor of 10. Based on these results, we are now designing a next-step experiment to

countermeasure this brittle bone phenomena which occurs in space. If the countermeasure is verified effective in space, it will pave the way to help people suffering from bone resorption on Earth. To evaluate the efficacies and the potential side effects of these countermeasures, longer experiment duration in space, such as that aboard the Space Station, is required.

Let's take the IML-2 mission as an example of US-Japan cooperation. The United States provided essential elements for the mission such as the Space Shuttle and its operations including resource and timeline management. Japan provided several facilities for experiments, such as, an Aquatic Animal Experiment Unit, and Japan gave fifty percent of their allotted time for their facilities to the US investigators who wanted to use them for their own experiments. This, thereby, greatly reduced the overall expenses for the mission for both space agencies.

Allow me here to mention a private concern which I had before the mission. When I started to work for this flight, my first thought was "how are we going to make a team out of people from 15 different countries, people from 6 different space agencies, several NASA flight centers and hundreds of scientists .....how are we ever going to be able to function as one team together?" I am proud to say that we did just that.

As the leader agency, NASA did a wonderful job in distributing the precious resources of crew time, electrical power and so on to the 82 investigators and integrated a very efficient time line.

The aspects of crew operations were both exciting and rewarding in terms of international benefits of this mission.

The crew discovered that we could provide the "link" between agency and agency, scientist and scientist, and engineer and engineer. This liaison function was shown in terms of language,

procedures, and learning and adapting one culture to another. Our networking resulted in resource sharing among the agencies and scientists, thereby maximizing the scientific output to all parties. This multilateral collaboration further resulted in a greater sharing of data, and a dramatic reduction in redundancy.

A perfect illustration of this team spirit was during our flight. The cooling system of the Japanese electrophoresis unit inside the Spacelab was shutdown because of air bubbles and we could not run any experiments. Based upon standard operational procedures, we continually purged water in the system, to no avail. After determined communications between all of the agencies, we were told to take some pieces off the European facility, some pieces off the Space Shuttle and some pieces from the Japanese hardware, in order to build a special water purging device. In addition, the Canadian team changed their experimental time line, a very generous offer as time is a precious commodity, to allow for the fixing of the unit. This option was formulated by the people of the Marshall Space Flight Center, the Johnson Space Center and the Kennedy Space Center. It was only through this extraordinary global effort and the leadership of NASA that such a solution was successfully realized.

Through the IML-2 experience, I felt that the science community was hungry to be involved with science in space. We encountered language, cultural, operational, and procedural differences which, at times, were difficult. Yet, we can say that for all participants, we were successful in our quest for a productive and beneficial mission. Indeed, the IML 2 was one of the most successful Spacelab missions. It was, and still is, a great honor for me to have the pleasure of working with such outstanding people as in the IML-2 mission. I hope this wonderful experience and expertise we have gained as a team can contribute to future missions.

Now, I would like to move forward to the future of US-Japan cooperation in manned space programs.

In the near future, Mr. Koichi Wakata, Japan's first Mission Specialist, will fly on the Space Shuttle Endeavor for STS-72 in January 1996. The Space Flyer Unit (SFU), a Japanese satellite launched by a Japanese H-II rocket, will be retrieved by Mr. Wakata using the Space Shuttle's manipulator arm.

In 1997, the first element for the International Space Station will be launched. Japan will provide to that Program, the Japanese Experiment Module (JEM). Procurement of parts and components for the JEM flight model has begun in Japan, and JEM will be launched in 2000 by the Space Shuttle. In return for the US provided resources such as electricity and oxygen, Japan will offer fifty percent of the use of JEM to the US to conduct experiments.

Further supporting this program, this September, NASDA began efforts to recruit the fifth Japanese astronaut candidate, who will work on the assembly of JEM for the Space Station.

With this history of US-Japan cooperation in mind, the manned space program is understood in today's Japan basically from four aspects.

First, science and technology are integral driving forces for Japan to realize national development complementing its limited natural resources. And space development, particularly advanced R&D, will be essential for the future of Japan. Ultimately, this will contribute to the well-being of people all over the world.

Second, international cooperation is essential for Japan in order to realize a manned space program. Previous examples of successful cooperation with the United States in manned space activities have made the Japanese people feel that international cooperation will result in greater achievements.

Third, manned space program contributes to education. It enhances people's motivations, and, dreams to seek better ways

of life. Many people both children and adults, to whom I have talked with after my flight, expressed great interest in the future possibility that they themselves will be able to travel, live, and work in space. What is noteworthy here is that Japanese children today believe they can become professional astronauts, whereas when I was a child, to be a Japanese astronaut seemed an unbelievable dream. The manned space program also teaches these potential Astronauts the importance of dreams, of science and technology, of teamwork and of being a good member in the international society on our planet.

Fourth, the space program makes us aware that this small planet is the only place for humans to live. We need to cooperate with each other and share as well as protect our precious Earth, for ourselves and our children. Although it is not visible, I would like to say that this awareness which I call a "spiritual spin-off" is one of the most beneficial from the space program. For without awareness, nothing comes into being.

To enjoy those benefits of manned space program now and in the future, Japan is determined to maintain its commitment to the Space Station Program. Thanks to the cooperation with the US, the Japanese manned space program today is able to contribute to manned space endeavors with the US and others such as the International Space Station Program.

Japan will continue to support the International Space Station Program as led by the United States by developing Space Station facilities for space experiments, by sending Japanese Astronauts to be trained at NASA, and by exchanging information and idea in the field of advanced science and technology. In the future, I hope Japan will be able to contribute to transporting materials to and from space using the H-II launch vehicle. These Japanese resources will extensively contribute to the international space community. I hope the US and Japan will continue its cooperation in order to advance global science and technology, and for the

betterment of human welfare into the twenty first century.

With imagination and creativity, we, as fellow human beings, can devise better ways to cooperate. With courage, we can implement those better ways. The IML-2 mission did it, and I believe that we, as an international team, will continue to progress with the Space Shuttle to the Space Station, and beyond. We have everything to gain.

On a personal note, I am grateful to have had the opportunity to journey into space. As an earthling once again, I feel that my good fortune yet continues. Being invited here today, I welcome the opportunity to personally extend my heartfelt gratitude to all of you in this room. It was the American people, who taught me the idea
that "if you can dream, you can do it." It was your support and encouragement, that has shouldered me throughout my quest to seek out new knowledge. And I thank you.

-- end --

NAME: Chiaki Mukai, M.D. PhD.
Astronaut, National Space Development Agency of Japan

BIRTHPLACE AND DATE : Tatebayashi, Japan ; May 6, 1952

MARITAL STATUS : Married to Makio Mukai, MD. PhD , No Children

EDUCATION : Received a doctor of Medicine degree in 1977 and a doctorate in physiology in 1988 from Keio University School of Medicine.

OFFICIAL COMMENDATIONS :

1993 ・ Japan Society of Aeronautical and Space Science's Commendation for Technology

1994 ・ Prime Minister's Special Citation
・ Minister of State for Science and Technology's Commendation
・ People of Gunma Prefecture's Certificate of Appreciation
・ Honorary Citizen of Tatebayashi City
・ National Space Development Agency of Japan's " Outstanding Service Award "
・ Tokyo Women's Foundation's Award for Distinguished Accomplishments

1995 ・ US Congress, " Special Congressional Recognition "
・ Satte Junior Chamber of Commerce " Happy Hands Award "
・ Aeromedical Association of Korea Honorary Membership
・ Tatebayashi Children's Science Exploratorium Honorary President
・ Prime Minister's Special Citation for Contributions to Gender Equality
・ The Federation Aeronautique Internationale " The De La Vaux Medal "
・ The Award for Distinguished Service in Advancement of Space Biology, Japanese Society for Biological Sciences in Space,

PERSONAL HISTORY : After graduating from Keio University, Dr. Mukai worked as aident in general surgery at Keio University Hospital. She has also been a part of the medical staff in general surgery at Shimizu General Hospital and emergency surgery at Saiseikai Kanagawa Hospital.
She returned to Keio University Hospital as a resident and later was promoted to a chief resident and instructor of the Department of Cardiovascular Surgery, Keio University.

In 1985, Dr. Mukai was selected by the National Space Development Agency of Japan (NASDA) as one of the three Japanese payload specialist candidates for the STS−47 flight. As a NASDA Science Astronaut, she became a visiting scientist at the Division of Cardiovascular Physiology, Space Biomedical Research Institute, Johnson Space Center. She is also a research instructor of the Department of Surgery at Baylor College of Medicine, Houston, TX. In 1994, she flew on The Second International Microgravity Laboratory (IML−2) mission as a Payload Specialist.
The mission consisted of 82 investigations of Space Life Science (Human Physiology, Space Biology, Radiation Biology, and Bioprocessing) and Microgravity Science (Material Science, Fluid Science, and Research on the Microgravity Environment and Countermeasures). IML−2 was also designated as an extended duration orbit mission focusing on medical experiments related to the cardiovascular system, autonomic nerve system, and bone and muscle metabolism.

As an active Science Astronaut with a medical and life science background, she supports the space medicine and life science experiments program by introducing and promoting Japan's space utilization program to the scientific community. Her exprience in animal, clinical and spaceflight research contributes to both science and engineering communities in Japan for developing future experiments and their supporting facilities in Space

The CHAIRMAN. Well, we thank you very much for that inspiring testimony. I think it does speak volumes about the kind of cooperation that we have achieved in these programs and what it means to both the Japanese people and the American people. And we thank you very much.

Mr. Brown, I would be happy to recognize you for any questions you might have.

Mr. BROWN. I am not sure it is appropriate to ask questions, but let me also express my deep appreciation to all the witnesses and particularly Dr. Mukai for that inspiring testimony. I think that you are the first person in any discussion before the committee who has admitted to the possibility of a spiritual spinoff from the space program. I am particularly interested in that as I think the growth of the human spirit is extremely important to all of us.

I note that you have received an award from the Prime Minister in Japan for contributions to gender equality. In a sense that is a form of spiritual spinoff.

The CHAIRMAN. Let me tell you what all the bells and whistles and buzzers are about. We are being called to the floor for a vote. It is my understanding that we will have two votes back to back, one on the previous question and the next one on passage of the rule on the Medicare bill. So, it will take us probably about 20 or 25 minutes until we are able to return from those votes. So, what we will do here in a couple of minutes is we will break to go over and vote and then come back.

Mr. BROWN. Let me try and get in my request to you, Dr. Mukai, for just one comment. With regard to your commendation from the Prime Minister with regard to gender equality, have you perceived in Japan any results from your flight in terms of the greater acceptance of women into science and other areas where there has historically perhaps been some difficulty for Japanese women?

Dr. MUKAI. Yes. Actually thanks to your invitation to me to fly for the space shuttle, recently many Japanese women, especially the scientists or working for the development area, they said that they were very encouraged by my flight and also they encouraged me to do something. They always said that, Chiaki, you opened up the way for women to conduct something. So, my point is I am really interested to encourage people, especially women, who want to do something but sometimes hesitate to do something because they think that they are women. So, I really would like to contribute to that point.

Mr. BROWN. Well, we noted that same effect when the first American who flew, Dr. Sally Ride. It did a great deal for the ego of women throughout this country, and we hope that your example will have a similar effect throughout the world as far as women are concerned.

Mr. HALL. Would the gentleman yield just a moment?

Mr. BROWN. I was going to relinquish my time, but I will be glad to yield.

Mr. HALL. One of the members of this committee, who has continuously voted against the space station, stated as he left that if space flight made all American women who were 40 years old look like they were 20, he might change his vote.

[Laughter.]

Mr. BROWN. I yield back my time.

The CHAIRMAN. Thank you, Mr. Brown.

With that, I believe we will break for a few minutes. We will go vote and then the committee will return. The committee stands in recess.

[Recess.]

The CHAIRMAN. Mr. Ehlers, did you wish to be recognized here? Mr. Hall?

Mr. HALL. I will pass.

The CHAIRMAN. Mr. Gutknecht?

Mr. GUTKNECHT. No questions.

The CHAIRMAN. He has no questions.

Ms. Rivers?

Ms. RIVERS. No questions, Mr. Chairman.

The CHAIRMAN. Thank you.

Mr. Doggett?

Mr. DOGGETT. I have no questions, Mr. Chairman.

The CHAIRMAN. Mr. Ehlers?

Mr. EHLERS. Thank you, Mr. Chairman. Since everyone else has passed, I do want to express my deep appreciation to the panel and also offer a comment. I have no questions, but a comment because I think this is a trend that is going to become stronger in the future. By that I mean we must have international cooperation and international support of major scientific endeavors.

A few weeks ago I visited CNR, the European Center for Nuclear Research, and we talked about increased cooperation between the United States of America and that center which is already a cooperation of 19 member nations. I think it is very important that the United States participate in that endeavor with them.

The space program obviously is an international program. It is becoming increasingly expensive and we have limited resources in every nation. We must operate cooperative programs and share the experiments, the costs, and the benefits.

I also see in the future the fusion program. If we go ahead with the ITER fusion reactor or with some other approach to fusion, that has to be an international effort because once again the costs are huge, the potential benefits are also huge, but it is going to take a great deal of effort and time and money to get the project underway.

I believe eventually something like the Superconducting Super Collider will be built somewhere in this world, and once again that will have to be an international project.

So, I want to applaud the members of the panel for their participation in this event. I applaud NASA for the international aspects of the space program that we have. I applaud the nation of Japan for their participation and not just participation but contributions. You have done excellent work with this particular flight, and the results are very meaningful to everyone involved.

So, I want to applaud you and also make the comment that I believe this is the trend of the future for science in this nation and throughout the world and we hope that we will see much more cooperation of this sort in the future. Certainly we will welcome Japan's participation in the ITER fusion reactor if that is ever developed and built and in other projects in the future as well.

Thank you very much for coming.

The CHAIRMAN. Thank you, Mr. Ehlers. I want to congratulate Mr. Ehlers on that statement and also the witnesses that we have had before us today.

I too believe that in exploring some of the very important what, we call big science, in the future, it is going to be extremely important to have international cooperation. I believe that the partnerships that have been built with Japan over the last several years are the partnerships that are going to expand in the future and that in working cooperatively we are going to gain much of the new knowledge that is going to be necessary to characterize the next century. I think both of our nations understand that the world of the future and the economy of the future is going to be based upon new knowledge. Where we can be partners and gain that new knowledge together, we will strengthen not only our relationship, but strengthen the future of the world.

I am delighted that we have had this opportunity to have this exchange with you today. We thank you very much for coming before the committee, and I am sure that we are going to continue to have these kinds of relationships in the future.

With that, Mr. Brown and I would like to make a presentation to Dr. Mukai on behalf of the committee, a resolution commemorating the 50 years of cooperation in science and space.

Dr. Mukai, this is a resolution from the Committee on Science commemorating 50 years of cooperation in science and space between the United States of America and Japan, and just let me read the resolve clause.

[The resolution, as read by the chairman, follows:]

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U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE

Resolution

Commemorating 50 years of cooperation in science and space between the United States of America and Japan

Whereas 1995 marks the 50th anniversary of the end of World War II and the United States of America and Japan have, over the past 50 years, developed a strong cooperative relationship;

Whereas such cooperation, especially in science and space, has contributed greatly to the programs of both countries;

Whereas cooperation in space not only serves as a symbol of the close ties between the United States and Japan, but also furthers important goals in science and technology;

Whereas the conduct of joint human spaceflight missions has provided an especially valuable opportunity to develop a strong working relationship in space activities;

Whereas Chiaki Naito-Mukai, the first Japanese woman to fly in space, participated in the Space Shuttle mission STS-05 as a payload specialist in July 1904;

Whereas future joint exploration of space by the United States and Japan offers a profound opportunity for the betterment of humankind;

Now be it hereby resolved on this day of October 19, 1995, that the Committee on Science of the U.S. House of Representatives welcomes Chiaki Naito-Mukai as an Ambassador of Goodwill and, further, commends to the Governments of the United States and Japan an expression of desire to continue a strong program of cooperation in space.

Robert S. Walker
Chairman

George E. Brown, Jr.
Ranking Democrat

Dr. MUKAI. Thank you very much.
[Applause.]
The CHAIRMAN. The committee is adjourned.
[Whereupon, at 11:53 a.m., the committee was adjourned.]

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